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A DEVICE FOR MONITORING THE ENVIRONMENT OF A VEHICLE BEING PARKED

Background Information

The present invention is based on a device for monitoring the environment of a vehicle being parked, according to the species of the main claim. A device of this type is already known from German Patent 43 36 288 C1, in which, for expanding the vision field of a camera, means are provided for swiveling the camera.

Advantages of the Invention

In contrast, the device according to the present invention having the characterizing features of the main claim has the advantage that, on the basis of a simple, robust arrangement, reliable monitoring of the vehicle environment can be assured. Movable parts, which are therefore subject to wear, are avoided, and the dead angles of the video camera are included in the monitoring area, so that the driver receives a danger message also in response to, for example, persons situated in the dead angle of the camera, and not only when questionable obstacles are located in the vision field of the camera. Therefore, there is an economic distribution of functions in detecting objects and reporting to the driver, between the object-detection sensors, on the one hand, and the camera, on the other hand.

As a result of the measures indicated in the dependent claims, advantageous refinements and improvements of the device indicated in the main claim are possible.

It is advantageous that the existence of objects outside of the vision field of the camera can be represented separately via a display unit. As a result, the attention of the driver

is immediately guided in the direction in which the danger threatens, although he is still unable to detect anything through the video image.

It is particularly advantageous to provide an object-detection unit, which, for evaluating objects, processes both data from the object-detection sensors as well as the video images. Combining a plurality of sensor information units in an overall display has the advantage that the behavior of the system is always transparent because the driver can also check the information visually. The driver is not limited to the few parameters that isolated object-detection sensors would supply, such as the vehicle distance to the person behind. As a result, it is possible at any time for the driver, in a simple fashion, to carry out monitoring and driving correction.

The visual presentation of the results in the image of the recording video camera has the advantage that the driver can very effectively survey the situation, since he is accustomed to steer the vehicle based on visual information.

Further advantages are derived from the features cited in the further dependent claims and in the description.

Drawing

Exemplary embodiments of the present invention are depicted in the drawing and are explained in greater detail in the following description. The contents are as follows:

Figure 1 depicts a top view of a vehicle having a device for monitoring,

Figure 2 depicts a vehicle having a further device,

Figure 3 depicts a schematic representation of a further

device,

Figure 4 depicts a video display unit 55,

Figure 5 depicts a further video display unit 55', and

Figure 6 depicts a parking scene.

Description of the Exemplary Embodiments

Figure 1 depicts a top view of a vehicle 7. In the rear space of vehicle 7, a video camera 1a disposed, which monitors the rear area of the vehicle in a vision field 8a. Mounted adjacent to video camera 1a are object-detection sensors 9a and 9b, which are used to detect objects in environment sectors 10a and 10b, respectively. These environment sensors 10a and 10b directly adjoin vision field 8a, but they lie outside of it. In addition, forward-directed object-detection sensors 9c, 9d, and 9e are arranged in the area of the front bumpers of the motor vehicle, the sensors monitoring environment sectors 10c, 10d, and 10e, which are directed toward the front area.

Video camera 1a, non-movable and fixedly installed at minimal expense, covers a prescribed vision field 8a, which can be displayed to the driver by a video display unit arranged, for example, in the dashboard or the center console of the vehicle. Using object-detection sensors 9a and 9b, it is possible especially to detect objects that are approaching the area monitored by the camera but that are not yet registered in the image. Detected objects of this kind can then be reported to the driver even though they cannot yet be detected in the camera image. This can be, for example, a child that is approaching the vehicle from the side, although the driver cannot see this child either in the displayed image of the camera or in the rear view mirrors, because the child is located in the dead angle. The object-detection sensors are

configured, for example, as ultrasound, radar, video, or lidar sensors. Additional sensors 9c, 9d, and 9e can be used during parking maneuvers for measuring at all times the distance to the vehicle parked ahead or for detecting other (endangered) objects. If the distance to the forward vehicle or another object is too small, a message can be transmitted.

However, the additional sensors can also be installed at any location in the vehicle to monitor the corresponding environment. For example, the time-related vehicle area offers further installation possibilities, in which objects can be observed and appropriate warnings can be provided to the driver. If the object detection is carried out in a monocular fashion, economies can be achieved because only one camera is used. However, such methods have the disadvantage, in comparison to stereo methods, that they do not deliver very precise and dependable results. Precisely by combining monocular object detection with other sensors such as ultrasound sensors, precision and reliability can be significantly increased.

Figure 2 depicts vehicle 7, which has additionally installed video cameras 1b and 1c, whose corresponding vision fields 8b and 8c cover the front area of the vehicle. In this context, the cameras are mounted between object-detection sensors 9c, 9d, and 9e, so that the three aforementioned object-detection sensors, as a supplement to the cameras, monitor the peripheral areas of vision fields 8b and 8c. Furthermore, other object-detection sensors 9f and 9g are mounted in the rear part of the vehicle, their corresponding environment sectors 10f and 10g partially overlapping vision field 8a of the video camera 1a and therefore, as a supplement to the video camera, bringing these areas of vision field 8a into the monitoring area.

Providing additional object-detection sensors in the rear part of the vehicle results in increasing the reliability of object

detection by generating data redundancy. If vehicle 7 is operated using a trailer, then, in the event that the trailer obscures the vision field or the environment sectors of the rear camera or of the rear object-detection sensors, the trailer can be provided with an analogous monitoring device 1a, 9a, 9b, 9f, 9g, which is directed at the area behind the trailer. Thus vehicles in trailer operation can also support the driver during parking maneuvers.

Figure 3 depicts the schematic design of a device for monitoring the environment of a vehicle being parked, in which the totality of the video cameras is designated by reference numeral 1 and the totality of the object-detection sensors is designated by reference numeral 9. The video cameras and the object-detection sensors are connected to a control unit 20. Control unit 20 has an image processing unit 2, which processes the image data of video cameras 1. Image processing unit 2 delivers preprocessed image data to an object-detection unit 30, which processes both the preprocessed image data of the video cameras as well as the signals of object-detection sensors 9. Via an acoustical display 6, detected objects or danger situations can be reported to the driver. The acoustical display is arranged in the passenger area of the vehicle. A superimposition unit 40 is connected to image processing unit 2 and to object-detection unit 30. This superimposition unit 40 superimposes information supplied by object-detection unit 30 with respect to detected objects and the pre-processed image data from image processing unit 2 for representation in a video display unit 55 or 55'. Object-detection unit 30 is also connected to a maneuver calculating unit 50, which, from the object data of object-detection unit 30 and externally supplied parameters 4, for example the selected steering wheel angle, calculates driving maneuvers and transmits this data to superimposition unit 40 for visual representation in the video display unit. Maneuver calculating unit 50 is also connected to a control unit 90 for the purpose of independently carrying out a driving maneuver.

In control unit 20, the images of the video cameras can be pre-processed using image processing algorithms, and they can be displayed on a video display unit 55 or 55'. In this context, the algorithms of the control unit can also fall back on vehicle parameters such as speed and the steering angle of the steering wheel. In the video display unit, in addition to the image content of the cameras, supplemental information such as warnings about objects in the vehicle environment can also be displayed. The possibility also exists of generating warnings acoustically via acoustical display 6. In this context, image processing unit 2 includes algorithms for image preprocessing, such as noise suppression, image rectification, or the like. The processed images would be combined with supplemental image contents using superimposition unit 40 and would be displayed on the video display unit. Object-detection unit 30 receives data from the object-detection sensors and from the image processing unit. Known objects are transmitted to superimposition unit 40 for display in the video display unit and are also relayed to maneuver calculating unit 50 for calculating maneuvers. In order to calculate maneuvers, external parameters can be taken into consideration. The maneuver calculating unit can prepare the calculated maneuvers suitably for representation in the video display unit and, if appropriate, it can intervene in the control of the vehicle through a control unit 90. As examples of actuator systems, mention should be made of influencing the steering angle and intervening in the engine and brake control systems. Object-detection unit 30, in monitoring in the environment, does not initially presuppose a preestablished parking geometry or the like, but rather, on the basis of the actually existing image or object-detection data, generates a description of the environment. The modeling of the environment and the images of the cameras are thus combined into one representation by superimposition unit 40. This representation is used to inform the driver comprehensively about the current situation in the vehicle environment. In this context, the object detection system supplies the location and the number of objects and,

depending on the sensor system used, it can supply varying object sizes in varying degrees of precision. This data (size and distance of the objects) can also be displayed in the video display unit, by object-detection unit 30 also transmitting this data to superimposition unit 40 in the appropriate manner. Using maneuver calculating unit 50, the present device, in addition to passively monitoring the momentary situation in the vehicle environment, can also actively assist the driver in controlling the vehicle. Object-detection unit 30 transmits to maneuver calculating unit 50 the modeling data or the object-detection data of the environment. For certain scenarios, the vehicle course is then calculated by maneuver calculating unit 50. In what follows, a few advantageous possibilities are indicated:

1. The vehicle course yields to detected obstacles.
2. The vehicle course leads into a parking space parallel to the roadway.
3. The vehicle course leads into a parking space perpendicular to the roadway.
4. The vehicle course leads into a parking space diagonal to the roadway.
5. The vehicle course leads to a predetermined setpoint position between a plurality of obstacles, it being possible, e.g., to configure the latter. Thus an example of a setpoint position is the position in the home garage, and an example of an obstacle is the gate in front of this garage. For calculating the above-mentioned vehicle courses, it can also be taken into account that a trailer is attached to a vehicle and that the driver should initially countersteer in order to arrive at a predetermined setpoint position. Either the maneuver calculating unit is configured so that it automatically detects the above-mentioned different situations, or the driver has the possibility of selecting the corresponding parking variant in the selection means installed in the dashboard. Certain maneuvers, such as parking in the home garage or other standard maneuvers, can also be stored in the memory or be preprogrammed. For this purpose, the maneuver

calculating unit has a suitable program memory, from which the stored maneuvers can be retrieved.

From the above-mentioned considerations, the following gradations are yielded for the degree of vehicle intervention on the part of the device according to the present invention:

1. The images of the video cameras are displayed in the video display unit mounted in the dashboard or in the center console.
2. At the same time, object information, such as size, position, and distance, are overlaid in the appropriate manner.
3. Additionally, information regarding the vehicle condition is overlaid, such as the steering angle adopted, which determines the appropriate driving path, the vision angle of the vehicle with respect to the road (i.e., the angle of the normal through the automobile relative to the road normal), etc.
4. The steering maneuvers are calculated by maneuver calculating unit 50 and are displayed in the video display unit. The steering angle is calculated by the system as a function of the current situation and is overlaid on the camera image in addition to the current vehicle steering angle. On the basis of the overlaid steering angle, the driver makes a variance comparison and turns the steering wheel accordingly. In this manner, the driver continually maintains complete control. The necessary steering direction can also (additionally) be indicated by correspondingly overlaid arrows.
5. The device automatically sets the calculated steering angle via control unit 90, so that there is a direct intervention in the steering. However, the steering angle can at any time be overridden by the driver, and thus an individually appropriate steering angle can be chosen. The driver himself thereafter controls the vehicle longitudinal motion, i.e., the engine and brakes.
6. In a completely automatic operating mode, the device

controls the vehicle entirely automatically by intervening both in the steering as well as in the engine control on the basis of the calculated vehicle maneuvering data. Here too, the maneuver can at any time be broken off by the driver.

Object-detection unit 30 and maneuver calculating unit 50 in an alternative embodiment can be configured so that the active maneuver control is automatically broken off in accordance with Point 6, for example, in the following situations:

1. Objects, especially rapidly moving objects, appear in the driving area, especially in the rear vehicle area.
2. Objects were surveyed in a grossly mistaken fashion.
3. There exists an acute danger of collision with an object.
4. Endangered objects (living things) appear.

Figure 4 depicts an embodiment 55 of the video display unit for displaying the images supplied by the cameras and processed by the control unit. Video display unit 55 has an image area 12 as well as both vertical edge areas 13 as well as horizontal edge areas 14, which together form the border of image area 12.

In image area 12 itself, and in the vertical as well as the horizontal edge areas of the image area, colored bars are displayed for optically signaling objects in the vehicle environment that is not covered by the vision field of video camera (S). Additionally, at a suitable location, a pictogram 15 can be overlaid for representing the vehicle itself. In the environment of this vehicle, the position of detected objects can also be plotted. Video display unit 55 can advantageously be integrated in the dashboard or in the center console of the vehicle.

As the warning color, a signal color such as red can be used in the edge areas. Depending on which bar lights up, the driver knows immediately to which side of the vehicle he should direct his attention, although the camera image still

is not supplying any information to him. Additional support can be provided, parallel to this, by acoustical display 6.

Figure 5 depicts a further embodiment 55' of the video display unit. In image area 12, a cube 115 is depicted, which in its size and shape roughly represents a detected object. In area 116, data can be overlaid for the distance or the size of this object. Lines 16 mark the driving path of the vehicle, if the given steering angle were to be maintained. Lines 17 mark the driving path which the vehicle would cover if the driver were to follow the calculated route. Arrows 18, which light up, alternatively, depending on the direction in which the driver is supposed to turn the steering wheel, show him how he should steer in order to achieve the steering angle suggestion that is indicated by lines 17.

All of the cited information is superimposed in image area 12 along with the image of the video camera in order to provide rapid and precise information to the driver concerning the situation. When the vehicle guidance is performed manually, it is also possible, if sensors and cameras are also present in the forward vehicle area, to provide an automatic switchover between the front and the rear video camera depending on which gear the driver has currently selected.

Figure 6, by way of example, shows a parking maneuver of vehicle 7 behind parked vehicle 107 and in front of parked vehicle 108. The same reference numerals as in the previous Figures designate the same parts and are not described once again.

In particular, laterally arranged object-detection sensors 9a and 9b monitor areas that cannot be observed by fixedly-installed camera 8a, but which are relevant for parking, especially if careless pedestrians, for example, enter into the areas just outside vision field 8a of camera 1a. In this case, the driver receives through the video display unit an

appropriate warning and can act accordingly until these pedestrians once again move out of the dead angle of the vehicle. Front object-detection sensors 9c, 9d, and 9e also supply the precise distance to forward vehicle 107 and make parking easier for the driver especially in the case of vehicle chassis that are not completely visible, making the borders of the vehicle hard to determine from the driver's seat.